

MISCELLANEOUS.

On the Development of the Heteropoda. By M. H. FOL.

ALTHOUGH the excellent memoir of Krohn has furnished us with numerous and precise details as to the larval development and the metamorphoses of the Heteropod Mollusca, on the other hand we only possess very scanty and unsatisfactory data as to the commencement of their evolution, notwithstanding that the genus *Pirroloides* ought certainly to be regarded as one of the most favourable for the study of embryogeny.

The segmentation takes place in accordance with the same laws as in the Pteropoda, except that the first four spherules of segmentation are perfectly equal among themselves, and enclose the same proportions of nutritive vitellus or protolecith and of formative vitellus or protoplasm. Here also the nuclei disappear before each segmentation, and are replaced by molecular stars. My memoir on the development of the *Geryonides* furnished in 1873 the first known example, in the animal kingdom, of this mode of segmentation.

The segmentation being completed, the embryonic sketch presents the form of a cellular sphere, furnished with a central cavity, and of which the histological elements are larger and more filled with protolecith on the one side, the nutritive side, than on the opposite or formative side. This latter bears in its centre the two polar corpuscles. The nutritive side of the blastosphere enters afterwards into the other; and the aperture of invagination, which is at first very large, gradually narrows; *it is the primitive mouth*. This opening of invagination occupies at first the pole exactly opposite to that at which the polar corpuscles are; but this arrangement soon begins to change gradually. In fact one of the halves, which we may call the ventral half of the embryo, begins to grow much faster than the opposite half, so that it affects more and more a bilateral symmetrical form. The part of the ectoderm of the ventral surface which abuts on the primitive mouth constitutes a protuberance which will become the foot. Between this protuberance and the polar corpuscles a depression of the external lamella is produced, namely the preonchylian invagination.

The velum appears as a zone of cilia which passes between the preonchylian invagination and the polar corpuscles, and unites at the upper margin of the mouth. The polar corpuscles which adhere to the point of the external lamella which was opposite to the primitive mouth (that is to say, at the formative pole), are found to occupy nearly the centre of the velum at the time when the larva begins to turn. This relative displacement is due to the more rapid growth of the tissues of the ventral surface of the embryo. Now this ectodermic tissue, which occupies the centre of the velum, is precisely that which gives origin to the cerebroid ganglia, the tentacles, and the eyes. The cells from which these nervous organs are

derived occupy, therefore, originally the formative pole of the embryo. It would be easy for me to found on this curious observation a theory of the *neuræa* as a sequel to the *gastræa* of M. Hæckel. The *neurula* would be a *gastrula* which would possess, at the pole opposite to that occupied by the aperture of invagination, cells destined to become the central nervous system and the eyes; it might be compared to the Ctenophores in the adult state, as well as to the embryos of many of the higher animals; but I have not any predilection, I must confess, for hypotheses of this kind.

The primitive mouth soon penetrates into the interior of the embryo; and the neighbouring parts of the ectoderm afterwards follow it, constituting an infundibulum which becomes the œsophagus with the sac of the radula. At the bottom of this infundibulum there is a fine ciliated canal, by which it communicates with the cavity of the inner lamella. This canal corresponds to the primitive mouth, which does not close up at any moment. This observation, so easy to verify in *Firoloides*, sufficiently refutes the opinion of certain phylogenists who believe that the primitive aperture of invagination in the Gasteropods becomes the anus, and annihilates all the conclusions that they have drawn from this supposition. It is by this ciliated canal that the albumen of the egg penetrates into the digestive cavity, or the primitive cavity of invagination. The cells of the inner lamella absorb this albumen, and deposit it in their interior under the form of strongly refracting masses, which I shall name the deutolecith. It is nevertheless only at the ventral part of the ectoderm that this storing of nutritive substance takes place, the rest of the lamella preserving its character of embryonic cells. At its aboral part it furnishes a hollow prolongation, which unites with the ectoderm below the foot to form the intestine and the anus.

The preonchylian invagination becomes filled with a viscous brownish substance; then it spreads out, and the viscous substance extends into a thin layer, which hardens on contact with the seawater, and constitutes the apex of the shell.

The otcysts are formed by invagination of the ectoderm on the sides of the base of the foot. The cerebroid ganglia detach themselves from the internal surface of the part of the ectoderm circumscribed by the velum, the same which afterwards gives origin to the tentacles.

The ventral part of the entoderm forms a sac, which occupies the apex of the shell; it is the nutritive sac. The rest of the walls of the embryonic digestive cavity gives origin directly to the intestine and stomach, which remains in communication with the nutritive sac by a large aperture. After hatching, the deutolecith contained in the walls of the nutritive sac becomes disaggregated, and falls into the stomach to serve for the nourishment of the larva. This sac afterwards acquires a lobed form, and gives origin directly to the liver.

The retractor muscle originates in a small number of cells, which

detach themselves from the internal surface of the ectoderm in the middle of the dorsal region, elongating and attaching themselves to the velum on the one hand, and to the apex of the rudiment of the shell on the other.

The branchial cavity is a depression of the ectoderm, which is produced between the margin of the shell and the neck of the larva on the dorsal side behind the anus, which is situated to the right. The mucus-gland is originally a depression of the ectoderm in the middle of the upper surface of the foot. The larvæ brought up in captivity all die at this degree of development: the sequel of their evolution has not yet been observed in a manner complete enough to be the subject of a communication.—*Comptes Rendus*, September 13, 1875, p. 472.

On the Sexual Reproduction of the Vorticellians.

By M. BALBIANI.

Since the time of Spallanzani (1776) it has been generally admitted that the Vorticellians are reproduced by gemmiparity or external budding. Professor Stein, of Prague, has the merit of having shown that this belief only rested on an illusion, and that what was taken for a bud separating itself from the parent was in reality the conjugation of two individuals of unequal size fusing into a single animalcule. M. Stein sees in this phenomenon a multiplication of the Vorticellians by sexual reproduction, and, as the description which he gives of it differs considerably from the picture which I have traced of this mode of reproduction in the other Infusoria, he uses it as a weapon for attacking my works on this subject. Let us first see how M. Stein describes the facts which he has observed, and take for example his observations concerning a Vorticellian living in a colony, and one of the most widely spread, namely *Carchesium polypinum*.

By successive and rapid binary divisions a certain number of individuals of the colony break up into groups composed of four or eight individuals, the size of which is, in consequence, four or eight times as small as that of the ordinary individuals. They remain at first united at the extremity of their common peduncle, and then detach themselves from it successively by the agitation of the cilia which form a crown at their posterior extremity.

As soon as it is free, each of these little individuals, or *microgonidia* (the name given to them by M. Stein), whirls rapidly about between the branches of the bush formed by the colony, and at last makes choice of one of the large ordinary individuals, on the side of which it fixes itself by its posterior extremity. The body-walls of the two individuals are absorbed at the point of contact; and they then communicate freely by their central cavities. During this time the elongated and cylindrical nucleus of each is divided into a number of small rounded fragments, which are dispersed irregularly in the internal parenchyma. Soon after, all the contents of the micro-